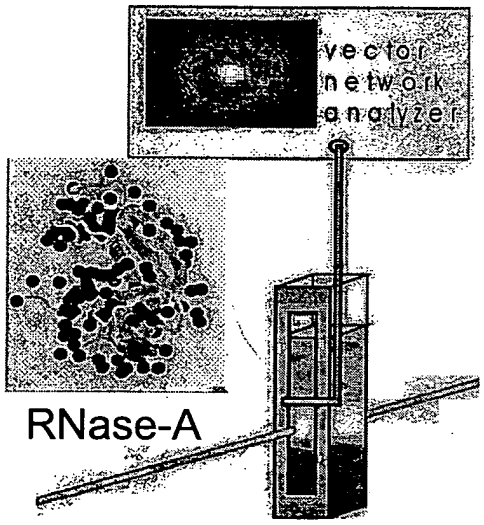
THz Frequency Science & Technology

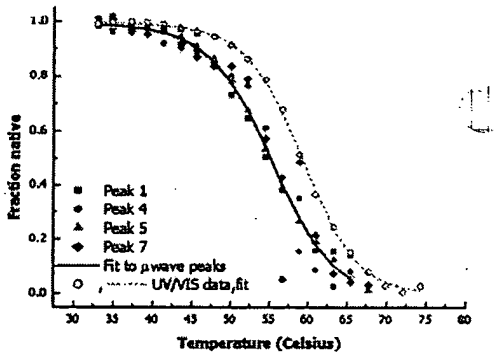
Biomolecular Interaction Sensing with Sub-Terahertz Fields

Daniel van der Weide - University of Wisconsin-Madison

Objective: To describe and develop the means for sub-THz electromagnetic field generation and detection around surfaces and small volumes sensitive to protein-protein interactions, DNA hybridization and other conformational changes central to biosensing and threat detection.

Description of Effort: To perform accurate measurements in this regime requires both new sensing surfaces (antennas, transitions, chemical functionalization) and instrumentation. The objectives of this effort are to use bound water as a reporter for label-free transduction of biomolecular interactions in volumes and on surfaces in the sub-terahertz regime based on the group's successful designs at lower frequencies





Curves identical for microwave and optical sensing

Benefit to warfighter: Enables field-deployable sensors that can be remotely queried and integrated with existing wireless communications equipment; also useful to clinicians for point-of-service medical diagnostics.

Challenges:
- **Need new sensing surfaces (antennas, transitions, chemical functionalization)—collaborating with chemists**
- **Need to scale from microwave to THz frequencies for smaller, more efficient antennas—have expertise here**
- **Need to develop field-deployable instrumentation—already started on this task**

Maturity of technology: Basic research (6.1)

Business Area: Label-free biosensing of DNA, protein conformation—applicable to drug discovery

Major goals/milestones by FY:

2002: Probe solution proteins with microwave and sub-THz energies using resonant techniques; confirm optically

2003: Sense and possibly control DNA hybridization both in solution and on surfaces in the sub-THz regime

2004: Integrate sensors as elements of "protein chips" based on surface-sensitive transducers

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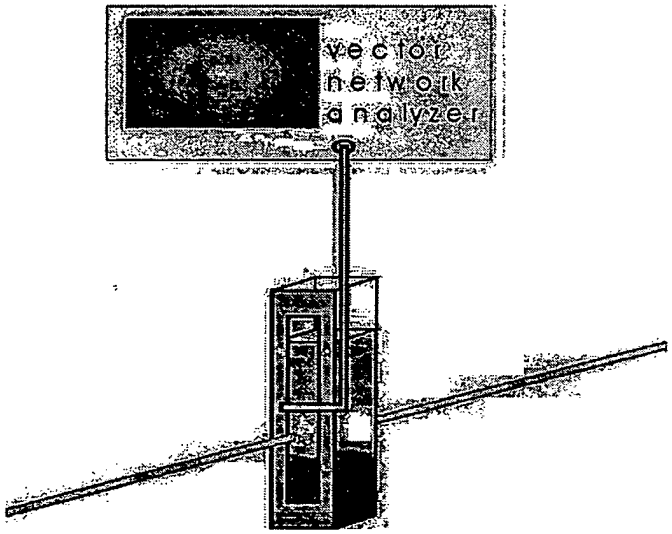
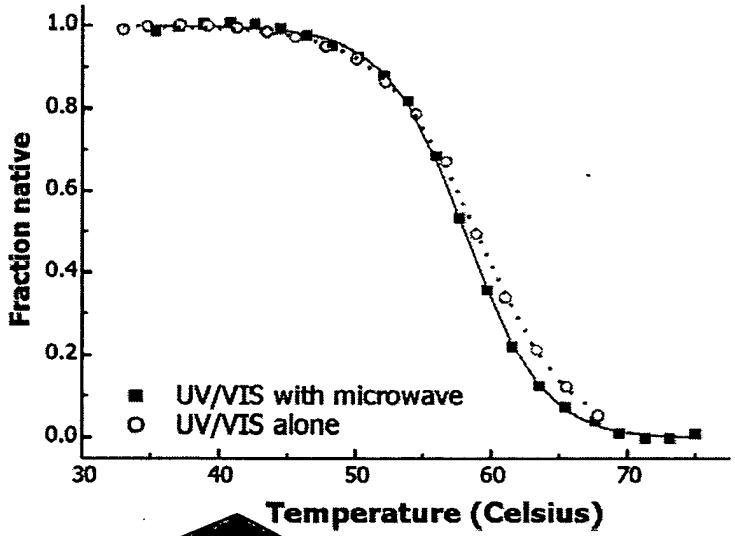
Experimental setup



magnitude & phase information used to determine resonant absorption characteristics which were fitted to a two-state folding model.

Protein unfolding: comparison of UV/VIS with microwave reflection



	ΔH_m (kcal/mol)	T_m (°C)
UV/VIS with microwaves (■)	76.8	58.1
UV/VIS alone (O)	61.3	59.2